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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
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| 09/769,490 | 01/26/01 | ITOGA K | 49657-961 |

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| EXAMINER | |
|---|---|
| KAO, C | |
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| 2882 | |

**DATE MAILED:** 08/01/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/769,490 | ITOGA ET AL. | |
| | Examiner | Art Unit | |
| | Glen Kao | 2882 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-45 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-45 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. § 119**

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 09/769,490 .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

**Attachment(s)**

15) ☒ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 1 .
18) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1, 2, 4-8, 13-17, 19-21, 24, 25, 27-31, and 36-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al. (U.S. Patent 6,219,400 B1) in view of Cash, Jr. (U.S. Patent 6,049,588). Hasegawa et al. discloses the following:

an x-ray exposure apparatus comprising an x-ray mirror (Fig. 1A, #102) and comprising any one of the following: a synchrotron radiation source (Fig. 1A, #101), said x-ray mirror with a function of converging x-rays (col. 2, lines 29-31), said x-ray mirror with a function of magnifying the area of a region capable of being simultaneously irradiated with x-ray outgoing from said x-ray mirror (Fig. 1A), an x-ray converging mirror (col. 2, lines 29-31), a magnifying mirror with a function of magnifying the area of a region capable of being simultaneously irradiated with x-rays outgoing from said x-ray mirror (col. 2, lines 23 and 24), a plurality of mirrors (col. 10, line 15), the outgoing direction of x-rays outgoing from the x-ray mirror being substantially identical to the incidence direction of x-rays incident upon said x-ray mirror initially reached by x-rays (Fig. 1B), and the outgoing optical axis of x-rays outgoing from said x-ray mirror is substantially identical to the incidence optical axis of x-rays incident upon said x-ray mirror initially reached by x-rays (Fig. 1B),

an x-ray mirror (Fig. 1A, #102) with any one of the following functions: reflecting x-rays included in radiation outgoing from a synchrotron radiation source, (Fig. 1A, #101), said x-ray mirror converging x-rays (col. 2, lines 29-31), and said x-ray mirror magnifying the area of a region capable of being simultaneously irradiated with x-ray (Fig. 1A),

an x-ray exposure method comprising an x-ray incidence step of making x-rays incident upon an x-ray mirror (Fig. 1A) and an exposure step of performing exposure with x-rays outgoing from the x-ray mirror (Fig. 1A and col. 1, lines 29-33) along with comprising any one of the following: an x-ray outgoing step of making x-rays outgo from a synchrotron radiation source (Fig. 1A), the x-ray incidence step including a step of converging x-rays with said x-ray mirror (col. 2, lines 29-31), the x-ray incidence step including a step of magnifying the area of a region capable of being simultaneously irradiated with x-rays outgoing from said x-rays with said x-ray mirror (Fig. 1A), an x-ray incidence step including a step of further converging x-rays with a converging mirror (col. 2, lines 29-31), an x-ray incidence step including a step of magnifying the area of a region capable of being simultaneously irradiated with x-rays outgoing from said x-ray mirror with a magnifying mirror (col. 2, lines 23 and 24), employing a plurality of x-ray mirrors in an x-ray incidence step (col. 10, line 15 and Fig. 2), the outgoing direction of x-rays outgoing from the x-ray mirror being substantially identical to the incidence direction of x-rays incident upon said x-ray mirror initially reached by x-rays in said incidence step (Fig. 1B), the outgoing optical axis of x-rays outgoing from said x-ray mirror being substantially identical to the incidence optical axis of x-rays incident upon

said x-ray mirror initially reached by x-rays in said x-ray incidence step(Fig. 1B), and a semiconductor device manufactured with the x-ray exposure method (col. 1, lines 9-11),

a synchrotron radiation apparatus comprising the following: a synchrotron radiation source (Fig. 2, #1), an x-ray mirror group including a plurality of x-ray mirrors (Fig. 2, #2a and 2b) upon which radiation outgoing from the synchrotron radiation source is incident (Fig. 2), the outgoing direction of radiation outgoing from the synchrotron radiation source and the outgoing direction of reflected light outgoing from the x-ray mirror group are substantially identical (Fig. 2), and the outgoing optical axis of said radiation outgoing from the synchrotron radiation source and the outgoing optical axis of reflected light outgoing from said x-ray mirror group are substantially identical (Fig. 2),

and a synchrotron radiation method employing a synchrotron radiation apparatus comprising a synchrotron radiation source (Fig. 2, #1) and an x-ray mirror group (Fig. 2) including a plurality of x-ray mirrors (col. 10, line 15) upon which radiation outgoing from said synchrotron radiation source is incident, which has the following steps: a radiation incidence step of making radiation outgoing from the synchrotron radiation source incident upon an x-ray mirror (Fig. 2), a reflected light emitting step of emitting reflected light from said x-ray mirror group in a direction substantially identical to the outgoing direction of the radiation outgoing from said synchrotron radiation source (Fig. 2), and a step involving the outgoing optical axis of the radiation outgoing from the synchrotron radiation source and the outgoing optical axis of the reflected light outgoing from said x-ray mirror group being substantially identical (Fig. 2).

However, Hasegawa et al. does not disclose an x-ray mirror containing a material having an absorption edge only in at least either one of a wavelength region of less than 0.45 nm and a wavelength region exceeding 0.7 nm as to x-rays and containing a single type of mirror material selected from a group consisting of beryllium, titanium, silver, ruthenium, rhodium and palladium, nitrides, carbides and borides of these, diamond, diamond-like carbon, and boron nitride.

Cash, Jr. discloses a mirror containing beryllium, a material having an absorption edge only in at least either one of a wavelength region of less than 0.45 nm and a wavelength region exceeding 0.7 nm as to x-rays (col. 5, lines 37 and 38) and a functional equivalent of single type mirror materials selected from the group consisting of beryllium, titanium, silver, ruthenium, rhodium and palladium, nitrides, carbides and borides of these, diamond, diamond-like carbon and boron nitride.

It would have been obvious, to one of ordinary skill in the art at the time the invention was made, to prepare the functionally equivalent x-ray mirror of Cash, Jr. containing a single material with the absorption edge limitations specified in the claims with the x-ray apparatus, x-ray mirror, x-ray exposure method, synchrotron radiation apparatus, and method of using the synchrotron radiation apparatus of Hasegawa et al. because the use of a such a mirror material has the functional equivalence of having the said absorption edge limitations as shown by the applicant and would have been within one's ability with ordinary skill in the art to select such a mirror material to have such absorption edge characteristics.

2. Claims 3, 18, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al. in view of Cash, Jr. as applied to claims 1, 16, and 24 above, and further in view

of Howells (U.S. Patent 5,214,685). Hasegawa et al. in view of Cash, Jr. suggests apparatuses and method as described above. However, Hasegawa et al. does not disclose an x-ray mirror cutting shorter wavelengths absorbing at least 90% of x-rays of a wavelength region of less than 0.3 nm.

Howells discloses an x-ray mirror coated with rhodium, which has the characteristics of cutting shorter wavelengths absorbing at least 90% of x-rays of a wavelength region of less than 0.3 nm (col. 7, lines 14-17).

It would have been obvious, to one of ordinary skill in the art, at the time the invention was made, to prepare the x-ray mirror of 90% absorbance of wavelength regions of less than 0.3 nm of Howells with the apparatuses or method of Hasegawa et al in view of Cash, Jr. because the use of this mirror is for lithography is considered conventional as shown by Howells.

3. Claims 9, 10, 22, 23, 32, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al. in view of Cash, Jr. as applied to claims 1, 16, and 24 above, and further in view of Howells and Katsuoka et al. (U.S. Patent 5,931,723). Hasegawa et al. in view of Cash, Jr. suggests apparatuses and method as described above. However, Hasegawa et al. does not disclose an x-ray mirror surface upon which x-rays are incident being mechanically or chemically polished.

Howells discloses an x-ray mirror surface upon which x-rays are incident being polished (abstract, line 1). Katsuoka et al. discloses a mirror surface that is mechanically or chemically polished (col. 1,lines 25-26).

It would have been obvious, to one of ordinary skill in the art at the time the invention was made, to prepare the mechanically or chemically polished x-ray mirror surface of Howells

and Katsuoka et al. with the apparatuses or method of Hasegawa et al. in view of Cash, Jr because polishing x-ray mirror surfaces is considered conventional as shown by Howells. The choice of polishing mechanically or chemically is considered conventional as shown by Katsuoka et al.

4. Claims 11, 12, 34, 35, 44, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al. in view of Cash, Jr. as applied to claims 1 and 24 above, and further in view of Imai et al. (U.S. Patent 5,258,091) and Waldo (U.S. Patent 5,503,958). Hasegawa et al. in view of Cash, Jr. suggests apparatuses as recited above. However, Hasegawa does not disclose an x-ray mask with a membrane and absorber comprising: a membrane containing a single species selected from a group consisting of diamond, diamond-like carbon, boron nitride and beryllium, a membrane containing a material having an absorption edge only in at least either one of a wavelength region of less than 0.45 nm and a wavelength region exceeding 0.7 nm as to x-rays, and an absorber containing a material having an absorption edge in a wavelength region of at least 0.6 nm and less than 0.85 nm.

Imai et al. discloses an x-ray mask with a membrane (Fig. 2, #1) and absorber (Fig. 2, #2) comprising: a membrane containing a single species selected from a group consisting of diamond, diamond-like carbon, boron nitride and beryllium (col. 2, line 53), a membrane containing a material, diamond, which has an absorption edge only in at least either one of a wavelength region of less than 0.45 nm and a wavelength region exceeding 0.7 nm as to x-rays (col. 2, line 53), and an absorber containing a material (col. 2, lines 53-55). Waldo discloses an absorptive material with an absorption edge in a wavelength region of at least 0.6 nm and less

than 0.85 nm (col. 3, lines 8 and 9). (Using the equation for photoelectrons ($E = hc/\lambda$), a value of 1839 eV requires a wavelength of 0.676 nm).

It would have been obvious, to one of ordinary skill in the art at the time the invention was made, to prepare the membrane and absorber of Imai et al. and Waldo with the apparatuses of Hasegawa et al. in view of Cash, Jr. because the use of masks with those material characteristics can be employed in any type of x-ray apparatus using masks as shown by Imai et al. and Waldo. It would have been just a matter of engineering expediency to determine the characteristics for optimum efficiency.

***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Cairns et al. (U.S. Patent 4,110,625) discloses a silver mirror.

Early et al. (U.S. Patent 5,356,662) discloses beryllium in an x-ray mirror.

Miyake et al. (U.S. Patent 5,770,335) discloses an x-ray mask a diamond or boron nitride membrane.

Watanabe (U.S. Patent 5,923,719) discloses an exposure apparatus using synchrotron radiation and a plurality of mirrors.

Watanabe (U.S. Patent 6,167,111) discloses another exposure apparatus using synchrotron radiation and a plurality of mirrors.

Hasegawa et al. (U.S. Patent 6,256371 B1) discloses another exposure apparatus using synchrotron radiation and a plurality of mirrors.

Miyachi et al. (U.S. Patent 6,101,237) discloses a mask with tungsten or tantalum as absorptive material.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Glen Kao whose telephone number is (703) 605-5298. The examiner can normally be reached on M - F (9 am to 5 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Robert Kim can be reached on (703) 305-3492. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

gk
July 23, 2001

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